PUBLIC HEALTH

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Washington State Department of Health

Human Health and PBDEs Overview

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Outline

- Background and definitions
- PBDEs and human health
- Populations at risk
- Pathways
  - One word, different meanings
  - Constituents of a complete exposure pathway
  - On the trail, from beginning to end
- Conclusions

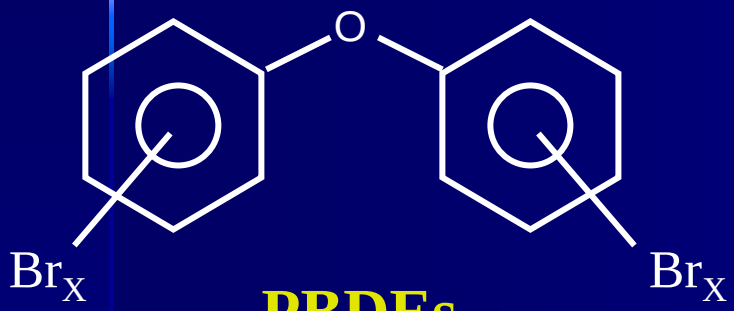
Background Definitions

- **3 types PBDEs**
  - **Penta-BDE (~5 bromine atoms), and**
  - **Octa-BDE (~8 bromine atoms) are**
    - Highly toxic
    - No longer manufactured
    - In products currently in use and in discarded, recycled products
    - In people and wildlife
  - **Deca-BDE (~10 bromine atoms)**
    - Less toxic than Penta and Octa
    - Lots of it in use
    - Can change in the environment into more toxic forms

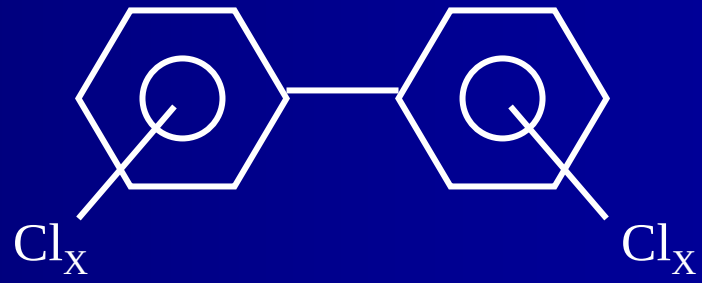
Why do we suspect PBDEs harm health?

- Animal studies
  - Conducted in many different labs
  - Finding similar things
    - Reliable and reproducible
- Similarity of PBDEs to another group of chemicals, Polychlorinated Biphenyls (PCBs)
  - Human health problems resulting from exposure to PCBs are well documented

PBDEs, PCBs and a thyroid hormone are similar looking



PBDEs



PCBs

Thyroxin (T4)

What kind of health problems?

- **Problems with brain development**
  - Can alter behavior, learning and memory
- **Reproductive effects**
  - Interferes with the endocrine system, reducing thyroid hormone (thyroxin)
    - Adequate levels of thyroxin in pregnant women is needed for proper brain development in offspring
  - Changes in egg and sperm formation in animals exposed to PBDEs have been seen
- **Liver effects** at higher doses
  - Changes to liver tissue, decreased liver weight
- **Cancer** (Deca-BDE only, very high levels)

Who is at risk?

Higher risk groups

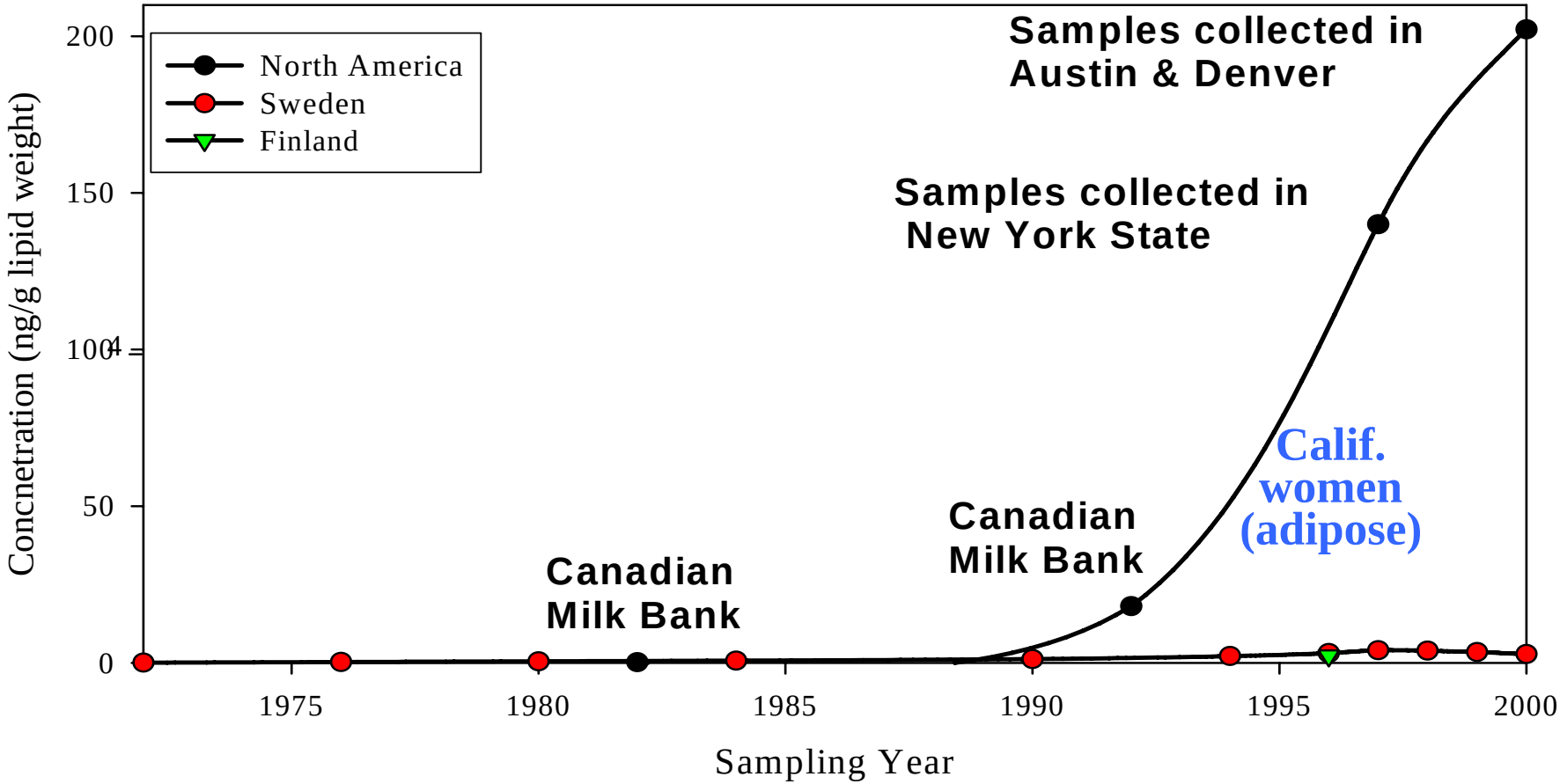
- Pre-natal period is key
- Infants and children are more susceptible
  - They are smaller than adults, they are growing faster
  - Eat more, drink more, breathe more than adults in relation to their body size = bigger dose
  - Play on the floor, hand to mouth behavior = bigger dose
- Workers in certain jobs
  - Data from occupational studies has shown elevated levels in workers
    - Electronics dismantling
    - Foam / rubber

Concern about Toxics and Kids is increasing

- Windows of vulnerability
  - Pre-natal, infancy/childhood
  - Brains are still developing through teen years

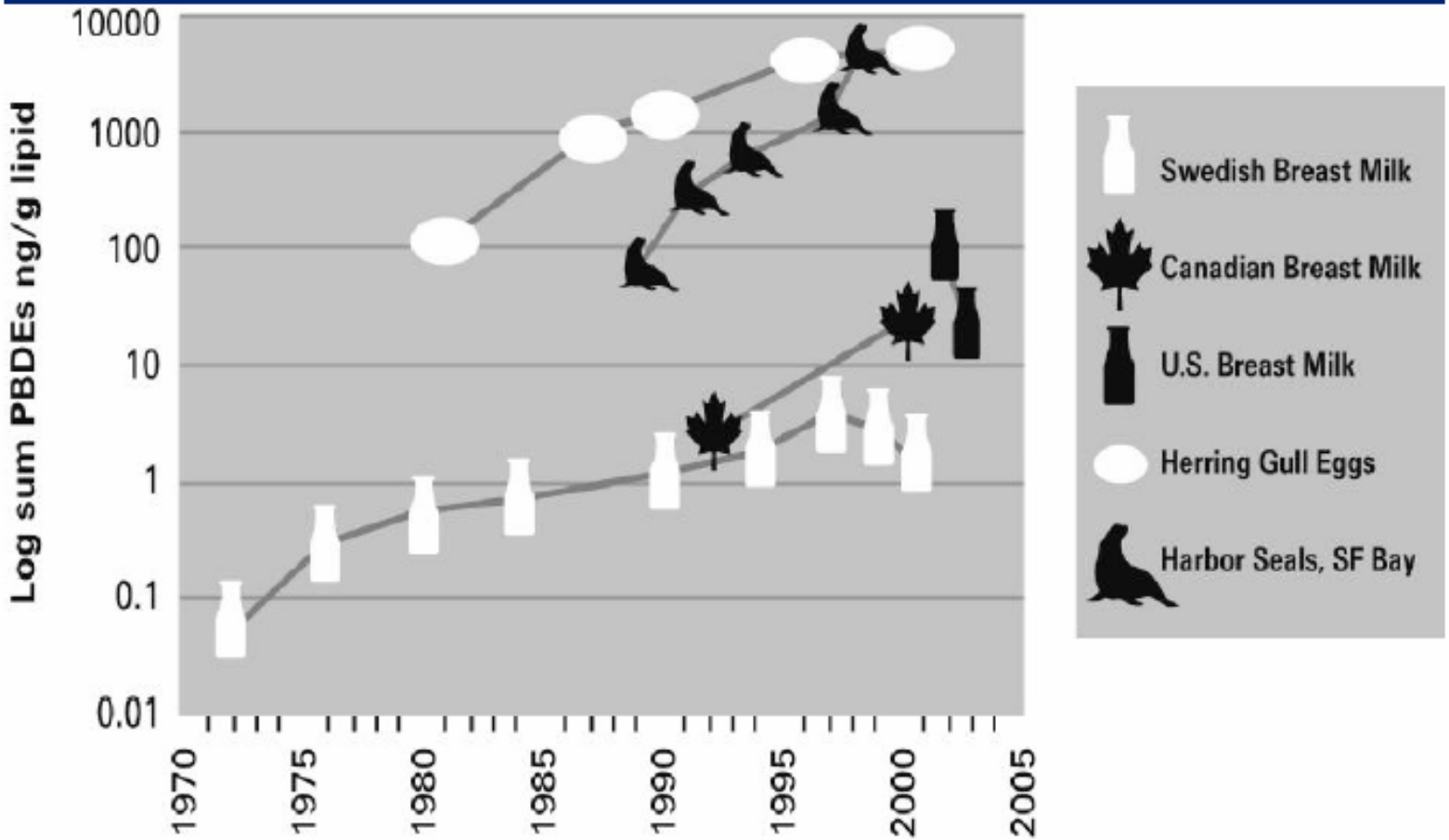
- Kids are not little adults
  - Breast milk contaminants
    - Breast feeding is still the healthiest way to feed babies. Numerous benefits, and protective factors in breast milk help to mitigate harmful effects of toxics.

Comparison Between Concentrations of PBDEs in Breast Milk from North America and Europe



Canadian Milk Bank and New York State from Ryan and Patry 2000, Denver and Austin results from Papke et al 2001; Swedish data from Meironyte Guvernius and Noren 2001, Finnish data from Strandman et al. 2000

Human and Wildlife Levels of PBDEs



Costs are Being Felt

- Neurotoxic chemicals are suspected to be a factor in the increase in developmentally related diseases:
  - About 17% of school-age children in the US suffer from a disability that affects their behavior, memory, or ability to learn *(Pediatrics, 3/94)*
  - Attention deficit/hyperactivity disorder (ADHD), autism

    *Estimated from 4-5 in the '80s -→ 30 – 60 in the '90s *(Journal of Autism and Developmental Disorders, 8/03)*
  - Costs in US estimated at $81.5 - 167 billion/year *(EHP Supplements, 12/01)*
  - WA State costs estimated at $2 billion per year

REF: *EHP Volume 114, Number 2, February 2006*
Focus - New Thinking on Neurodevelopment
Report by Kate Davies (www.iche.org)

Environmental Health Perspectives
Volume 114, Number 2, February 2006

Focus - New Thinking on Neurodevelopment

Pathways

- Medical & Public Health perspective: how a substance enters the body
  - Breath it (respiratory pathway)
  - Eat it (ingestion pathway)
  - Touch it (dermal absorption pathway)
- Environmental perspective:
  - Contaminant, transmission through media, cycling or arriving at an “end-of-life” location
- Webster’s: “the route or course along which something moves”

Exposure Pathways

- “The route a substance takes from its source, to its end point, and how people can come into contact with it” (ATSDR)

- Exposure pathway is complete if it contains:
  1. Source (PBDE containing products)
  2. Environmental media and transport mechanism (Does it migrate thru soils, water or air from landfills or incineration? Does sludge move it to fields, to food?)
  3. Point of exposure (home carpet, worksite, table or car)
  4. Route of exposure (breath dust, eat food, absorb through skin)
  5. Receptor population (us)

Different Pathways Impact Kids and Adults Differently

- **Indoor environment**
  - House dust is major exposure pathway for children (*Jones-Otazo, Clarke, Diamond et. al. "Environmental Science and Technology, 2005, 39, 5121-5130)*
  - Indoor air

- **Outdoor environment**
  - Little WA data, PSCAA does not measure in air
  - PBDE Technical Committee reviewing available state, national and international data

- **Food**
  - Potentially a major pathway for adults
    - Fish, but not just fish (*Texas / Schecter)*
    - Beef and other foods containing animal fat can be a major contributor
  - Breast milk is the major pathway for nursing babies

- **Occupational settings**
    - Very high levels in dust and air

(Swedish / Sjodin)

In summary

- PBDE concentrations are increasing in humans and wildlife
- PBDEs are a health concern
  - Bioaccumulative
  - Endocrine disrupters
  - Affect brain development
- Routes of exposure are still being identified
  - In home, office
  - Occupational exposure: recyclers, firefighters, others?
  - Air, soil, food
  - Product end-of-life

Slide adapted from Anne Blake, PhD 4/13/06

Conclusions

- Kids and the developing brain are sensitive to PBDEs
- Babies nurse, kids eat dirt. They crawl on the floor and breath the air around them.
  - Individual behavior (keep dust levels low, choose green products) is part of the answer
  - Pollution prevention is part of the answer
  - Safely managing disposal and recycling of consumer products after use is part of the answer

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